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Bibliometric Analysis of Cost and Time Management In Handling Avalanches on National Roads In Mountainous Areas Using BIM

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cost management; time management; avalanche handling; Building Information Modeling (BIM)

ABSTRACT
landslides on national roads in Indonesia's mountainous regions using BIM is a construction technology innovation that can help stakeholders to collaborate, visualize, and manage construction work well. The purpose of the study is to organize the literature and provide valuable insights into the research. The method used in the study was bibliometric analysis using the help of the Publish or perish application as a RIS and CSV metada withdrawal application, as well as the Vosviewer application. From the results of the analysis using the bibliometric method, there are 3 clusters of keywords and 26 keywords. In the development of the research year, the peak of research occurred in 2022, with the most dominant keyword BIM. The type of publication is dominated by journals by 33.7% and the most found publisher place is IEEE at 125. Based on the results of the analysis as a whole, America is the most dominant country and continent discussing research topics related to research topics.

Introduction

A disaster is an event caused by nature or non-nature that can cause serious damage, loss, and disruption to human life, animals, and the environment. Disasters can be caused by several factors such as nature, humans, and a combination of the two. Natural disasters that often occur are landslides. The lonngsor land is a mass movementsoilwhich descends the slope, as a result of the disruption of stabilitysoilor the rocks that make up the slope (Rahardian et al., 2021). Avalanches on national roads passing through mountainous regions are a problem faced around the world. Landslides often threaten traffic, damage infrastructure, and disrupt residents' lives. Therefore, building effective and measurable avalanche management strategies is becoming very important around the world.

Indonesia has a very diverse topography. This is one of the geographical characteristics of this country that affects its climate, flora, fauna and culture. Some of Indonesia's topographic characteristics include the mountains. Most of Indonesia consists

of mountains stretching from west to east. With its diverse topography and national road network that often passes through mountainous areas, Indonesia has a higher risk of avalanches. Landslides are one of the disasters that often hit Indonesia. Data collected from the Bogor City BPBD Office also shows that landslides are ranked first out of 6 types of disasters in Bogor City; In 2017 there were 179 landslides (40.5%) out of 442 recorded disaster events. To maintain connectivity and safety of national roads, handling these avalanches has become more important. As a result, to overcome this problem in Indonesia, a creative and effective approach is needed (Permadi et al., 2018).

Overcoming avalanches on national roads in Indonesia's mountainous regions using Building Information Modelling (BIM) will be discussed in this article. A development in construction technology, building information modeling (BIM) enables stakeholders to more effectively coordinate, visualize, and oversee construction projects. From planning to construction, operation and maintenance, BIM increases productivity and efficiency throughout the life cycle of a building (Pantiga & Soekiman, 2021). So that it can help its use visualize what will be built on site to identify potential design, construction or operational problems. For generations, the cost estimation process has been manual, time-consuming and error-prone (Suwarni & Anondho, 2021). The main focus of this article will be a case study covering an avalanche management project in the mountainous region of Indonesia. This case study will provide a first-hand perspective on BIM implementation in difficult environments.

In this article there is a problem that requires resolution, namely how the author can conduct a cost and time analysis using Building Information Modeling (BIM) in a national road avalanche handling project in mountainous areas. The author will describe the methods to be used to conduct cost and time analysis for avalanche handling projects on national roads in mountainous areas. The hypothesis of this study is that BIM will enable more efficient and accurate analysis of cost management and time management in avalanche handling. As such, we expect that this method will result in a more thorough and thorough solution to deal with avalanche problems in often complex mountainous environments.

The novelty of this study lies in its pioneering application of Building Information Modeling (BIM) specifically tailored to address avalanche management challenges on national roads in Indonesia's mountainous regions. While BIM has been extensively used in construction for enhancing coordination and efficiency, its application in natural disaster mitigation, particularly for avalanches, remains underexplored. By focusing on the unique context of avalanche-prone areas, this research breaks new ground by demonstrating how BIM can revolutionize the planning, execution, and maintenance of infrastructure projects vulnerable to natural hazards. The integration of BIM in avalanche management not only aims to improve cost and time efficiency but also promises to provide a comprehensive framework for stakeholders to visualize, analyze, and mitigate risks proactively. This approach represents a significant advancement in leveraging technology to enhance infrastructure resilience against natural disasters, thereby contributing to the broader field of disaster management and sustainable development.

The aim of this piece is to look into and analyze the various ways in which the use of BIM can help conduct more effective cost and time management analysis in avalanche management projects in mountainous areas on national roads. Due to use BIM enables more effective collaboration between construction project stakeholders, BIM provides better visualization capabilities, allows professionals to realistically visualize and analyze projects prior to their physical execution, BIM can optimize planning, reduce overlap,

and speed up the building process, BIM can facilitate easy access to updated building data and support more maintenance decisions intelligent (Putri & Handoyo, 2023). In addition, this article aims to provide practical guidance to construction professionals and policymakers facing problems in the analysis and management of avalanche handling projects in mountainous areas. Therefore, it is hoped that this article will provide important insights and assist in efforts to improve the sustainability of national road infrastructure in mountainous regions around the world.

Using bibliometric methods, this article aims to help organize the current literature and provide valuable insight into research progress, weaknesses, and contributions that have been made in the field of cost and time management in handling avalanches on national roads in mountainous regions with BIM. This study uses bibliometric analysis method using VOSviewer which is a method to explore and analyze scientific data and allow researchers to describe phenomena and their characteristics. A software program called VOSviewer is used to create and examine maps based on network data. Although it is aimed primarily at analyzing academic records, it can be used on any type of network data (social networks, for example). VOSviewer explores co-authoring, co-occurrence, citations, bibliographic coupling, and shared citation links in one of three possible representations: network visualization, overlay, or density. With VOSviewer, the results of bibliometric analysis can be used as a basis for research planning in this area. This will help researchers create better and relevant research questions (Pramesti et al., 2022). This article can be a useful reference source for researchers, practitioners, and readers interested in this topic.

This article explores the application of Building Information Modeling (BIM) in managing avalanche risks on national roads in Indonesia's mountainous regions. The objective is to assess how BIM technology can enhance the efficiency of cost and time management strategies in handling avalanche incidents. Indonesia's diverse topography, dominated by extensive mountain ranges, heightens the vulnerability of its national road network to landslides, which frequently disrupt traffic and threaten infrastructure. By adopting BIM, this study aims to bolster infrastructure resilience by facilitating better collaboration among stakeholders throughout the construction lifecycle. BIM's advanced visualization capabilities enable stakeholders to anticipate and mitigate design and operational challenges early on, optimizing project planning and execution. Furthermore, the research seeks to demonstrate how BIM supports accurate cost estimation and schedule management, thereby reducing project delays and budget overruns. Through bibliometric analysis using VOSviewer, the study also aims to consolidate existing literature on avalanche management with BIM, identifying research trends and gaps to guide future studies. Ultimately, this article aims to provide practical insights for construction professionals, policymakers, and researchers, enhancing the sustainability and safety of national road infrastructure in mountainous regions globally.

Literature Review

Cost Management

Managing costs is essential to complete a construction project quickly and within budget. Based on previous research, whatever the project objectives, cost and time management are essential in producing a quality project. Project success is directly influenced by interrelated cost and time management. Companies can gain a lot when projects are well managed in terms of cost and time (Arruda et al., 2022). Since from the early stages of project planning, the project team must strive to produce the most accurate cost estimates possible for all elements of the project. With accurate cost estimates,

projects can design realistic budgets. Based on previous research Cost and management accountants can act as accelerators of nation building with the effective application of cost control and strategic management techniques (Perera & Eadie, 2023).

Identifying, managing, and establishing cost reserves are important steps in project management that aim to reduce the negative impact of uncertainty and risk that arises during the construction process. Based on previous research, project risk is a factor that can affect the achievement of objectives, resulting in unintended consequences that can affect project performance, schedule and costs. Therefore, project risk management is essential to reduce adverse impacts. Changes in project scope, market uncertainty, bad weather, or HR management issues are some of the sources of project risk. Based on previous research (Karna, 2019) To reduce the negative impact of risks included in the dominant risk category (major risk), it is necessary to take risk mitigation measures. By reducing the likelihood of contract addenda brought about by differences in cost, quality, and timeliness, risk mitigation helps the project owner avoid fines for late delivery and contract termination to the implementation contractor (Fathoni, 2020).

Finding ways to reduce costs without compromising the quality of work or project safety is a task that requires careful balance and strategic thinking. To ensure that savings do not interfere with the end result of the project, these measures should be taken carefully and concentrate on operational efficiency, innovation, and risk management. Based on previous research, construction projects are a sector of work that has a high risk compared to other sectors. In construction projects high risk factors include project complexity, multi-stakeholder involvement, use of various technologies and materials, and reliance on laws and weather conditions. Developing an effective risk management strategy requires an in-depth understanding of the risks associated with construction projects (Rantung et al., 2018).

Time Management

Cost and time management are very important in a construction project, Combining the two can help a construction project reach its primary objective, which is to finish it within the allocated budget and time frame. Previous study indicates that three factors—cost, quality, and time—determine a building project's success.. Therefore, cost and time are very influential in a construction project, to ensure that the budget that has been set remains fulfilled, cost control is very important. Based on previous research, cost control involves close supervision of all expenditure components, such as equipment, labor, building materials, and others. Time control is also very important to ensure the construction project runs smoothly. Effective scheduling and frequent monitoring are essential for keeping projects on track. According to earlier studies, project cost control serves as a benchmark and a starting point for calculating the discrepancy between resource usage , planning (Ra) and realization (Re) (Oetomo et al., 2017). In addition to cost control, time and quality control are equally crucial for managing a construction project. Project managers must give these controls extra consideration because construction contracts have implementation and minimum time constraints (Lakaoni & Waty, 2023; Reis et al., 2020).

Cost and time management in a construction project will be faced with several significant challenges, potentially hindering its smooth running and success. The main challenge of cost and time management is unexpected changes in project scope. Scope changes are changes that include changes in design, specifications, or stakeholder needs, which can have a significant impact on project cost and time. Based on previous research Changes to a project in its implementation are often known as change orders. Change

orders are caused by several factors such as differences in field conditions with design drawings, changes in the scope of work, changes in plan drawings, inadequate equipment and others. Therefore, change orders have a significant impact on cost and other variables on construction projects (Nggebu et al., 2019).

Avalanche handling

A geological occurrence known as an avalanche is caused by the movement of rock masses or soil of different kinds, such as the falling of big boulders or soil clusters.. Based on previous research, landslides that occurred in The slopes around the study site have experienced landslides that resulted in material losses and traffic jams that impacted the economy. Severe soil erosion can also occur under conditions of high rainfall. Therefore, predicting land loss on highway slopes is important to protect infrastructure and human life. Thus, identification and control of potential landslide risks in the area is needed immediately. In addition, mitigation strategies are needed to protect infrastructure and local economic interests. In this regard, research conducted at such sites is essential to gain a deeper understanding of the causes of landslides and methods to reduce their risk (Li et al., 2019; Toyfur et al., 2020).

Landslides are one of the disasters that often occur in Indonesia, based on previous research the infrastructure that is often affected by landslides is roads. Roads as connecting access from one region to another will be greatly disrupted due to landslides. Avalanches on roads in mountainous areas often occur due to events where the land around the road becomes unstable and tends to move, caused by high rainfall, not strong enough to withstand loads such as motorcycles and cars with large loads. With unstable soil conditions, it can cause road sections to collapse, potentially endangering road users and damaging transportation infrastructure. Based on previous research, landslides can be triggered by soil characteristics formed in an area that is influenced by the size of the soil fraction, especially the finer soil fraction, namely the soil fraction of clay minerals (Isra et al., 2019; Jawat & Suwitanujaya, 2018).

Avalanche prevention methods are some of the actions taken to reduce the risks and impacts that occur in an area. Its main purpose is to maintain the safety of people and assets, as well as protect against the threat of avalanches that can occur due to human activities or natural factors. Avalanche prevention methods have many ways that can be used. Based on previous research to prevent landslides on road plots, the prevention effort carried out is to build landslide prevention methods in areas that are prone areas (Aziz, 2023).

Avalanche handling involves social and technical aspects. The literature highlights the role of local communities in avalanche mitigation, which includes participation in planning, engagement in emergency response, and capabilities for post-disaster recovery. In addition, the study pays attention to the analysis of government policies and development regulations that support avalanche mitigation. Based on previous research Mitigation efforts are very important to be carried out in disaster-prone areas, one of which is in helping to develop effective disaster communication. Preparing people in disaster-prone areas must always be done. Adequate information is the main thing needed in areas with disaster potential apart from training and internalizing habits to deal with disaster situations that are carried out on an ongoing basis. Optimized disaster communication produces useful communication in the context of disaster mitigation. Disaster communication has a huge role and advantage in mitigation. Based on previous research, disaster communication in the context of mitigation can provide rules or guidelines to the community. In another explanation, it is interpreted as a life course. At

the level of benefits, disaster communication has several aspects that can internalize society holistically. These include being able to change the attitude, being able to change the opinion or opinion or view (to change the opinion), being able to change the behavior, and being able to change the society (López et al., 2018).

Building Information Modeling

Recent understanding and developments in the application of Building Information Technology (BIM) reflect the transition to a more holistic approach in the management and execution of construction projects. BIM is not just a 3D design tool, but an information platform that involves the entire project life cycle, from planning to facility management. According to earlier studies, it is currently becoming more and more necessary to have trustworthy digital three-dimensional (3D) models that enable remote and decentralized project planning and management. Recent developments show the expansion of BIM into multi-disciplinary collaboration, asset management, and project performance analysis with the integration of geometric and non-geometric information. It facilitates better communication between stakeholders, such as architects, engineers, contractors, and project owners, through collaborative modeling that increases efficiency and reduces design conflicts. The application of BIM also extends to facility management, enabling maintenance optimization, energy performance monitoring, and effective change or update management. In conclusion, BIM reflects the evolution of the construction paradigm, becoming an integrated approach that utilizes information technology to support the entire project life cycle and facility management (Martínez-Aires et al., 2018).

BIM As an important component in improving efficiency and quality during the project life cycle, the use of Building Information Technology (BIM) in construction project management has been demonstrated by research conducted on the subject. The application of Building Information Modeling (BIM) is currently experiencing rapid growth in construction operations, planning and management, and Safety Management (Шалина & Ларионова, 2021). Studies show that using BIM in construction project management has the potential to generate many profits, but it must be managed properly to get optimal results. Based on previous research, BIM has significant benefits for the project life cycle even after its life cycle is complete, but these benefits cannot be obtained by the project due to the failure of the application of BIM technology in the construction industry (Ahmed, 2018).

To achieve success in construction projects when implementing Building Information Technology (BIM), there are several challenges that must be overcome. Based on past research, one of the most common obstacles faced in the construction industry is the fragmented delivery process and relies on paper-based documentation and communication. And some challenges in implementing BIM such as High start-up costs, lack of knowledge and skills, resistance to change, complex data management, information security, immature standardization and regulation, and large scale of projects are some of the major obstacles. But, based on previous research on the use of BIM in construction projects for its application, BIM technology has been used as a tool all over the world (Pantiga & Soekiman, 2021)(Kalfa, 2018).

Overall, the long-term benefits of using Building Information Technology (BIM) in construction projects include data accuracy, cost and time efficiency, and improved project quality. Based on previous research, Building Information Modeling (BIM) is an information system that processes input into information in the form of building modeling as a tool in the decision-making process at each stage of a construction project. One of

the modern approaches in project management is the introduction of BIM technology, which helps improve the quality of construction project design and project implementation process planning. Based on previous research on the impact of, BIM technology regarding the main risks of projects shows that with the help of this technology, it can be done to reduce most of the risks that lead to an increase in project costs, which in turn will contribute to the improvement of the economic efficiency of the project (Basir & Ujang, 2020)(Kalfa, 2018).

In addition, The benefits of using BIM for investors are a higher quality of construction and at the same time a lot of important information about the realized object . Because BIM is a time-saving system, effort and money can be provided reducing errors in the early design stages of a project. However, the use of BIM systems requires in-depth knowledge, skills, and expertise, and unfortunately the number of BIM experts is insufficient in many countries. Although BIM is widely used in managing construction information, the components of BIM-based information management are still little studied (Apriansyah et al., 2022; Hakim, 2020; Muhammad et al., 2023).

Research Methods

An Experimental section, In this article using the method Quantitative descriptive research with bibliometric analysis approach. The source data is obtained from the Scopus database with restrictions on articles published in the last ten years (Hutama & Sekarsari, 2018). The publication trends with the most documents, the university or institution rankings, journals, and documents, as well as the usage of keywords and Google Scholar databases the organization of rankings for institutions or universities, publications, and papers; the usage of keywords; and the utilization of Google Scholar databases (Шалина & Ларионова, 2021). Bibliometric research is conducted to find research trends and publication features related to the keywords discussed. Collection of metadata information using keywords. The keywords used are cost management, time management, avalanche handling, and BIM.

Use of the Publish or Perish software application to collect articles and related sources using keywords. The present investigation employs a Systematic Literature Review methodology, which entails a comprehensive search for, and assessment of, pertinent research findings pertaining to specific research questions, topics, or phenomena of interest. The publication of journal articles is sourced via the Publish or Perish application, which retrieves journal documentation of published scientific articles from the Google Scholar database. Version 8.9 of the publish or perish program was utilized by researchers. Researchers collected digital literacy metadata using keywords through the crossef database. Keywords such as cost management system, time management, avalanche handling, and BIM are used. The file types used for data storage in Publish or Perish are CSV and RIS. The CSV file type is used to analyze and process data using Microsoft Excel, and the results will be graphs and tables. RIS file types can be processed using Vosviewer, which produces network and map results (Шалина & Ларионова, 2021)vv.

Researchers use the Vosviewer (Publish or Perish) application to map and analyze the results of journals that have been collected in this study. VOSviewer is one of thesoftwareused in bibliometric studies. For data analysis, all data, including word co-occurrence networks created with VOSviewer, is exported to CSV format.. All information is exported to Research Format Information Systems (RIS) for analysis purposes using VOSviewer software. Map visualization, overlay visualization, and

density visualization are three forms of data processing output used to visualize relationships and group keyword-related search topics (Spirkova et al., 2022).

Results and Discussions

Publish or Perish

Based on the findings of an investigation of the metadata withdrawal for the software program publish or perish, version 8.9, via Crossef, within the 2000–2023 time frame

Table 1. Citation Metrics Results

Publication years	2000-2023
Citation Years	23 (2000-2023)
Papers	1000
Citations	7213
Cities/years	313.61
Cities/paper	7.21
Cities/author	3349.71
Papers/Author	1.79
Author/Paper	47
h-index	70
g-index	30
Hi,norm	1.30
Hi,annual	23 (2000-2023)
hA-index	1000

(source: Results of researcher analysis using Vosviewer)

Based on table 1 above, the results of metadata withdrawal research with a time range of 2000-2023 resulted in 1000 papers. With the number of citations 7213, the results of pulling the data source can produce two types of storage files. On RIS file types will be analyzed in Vosviewer software application version 1.6.19. The CSV file type will be analyzed using Ms.excel and produce a chart of the progress of the research year in the 2000-2023 time frame.

Year Development

Based on the results of metadata withdrawal from Publish or Perish related to research on bibliometric analysis of cost and time management in avalanche handling on national roads in mountainous areas using BIM with the keywords Cost management, Time management, Avalanche handling, and BIM, based on the results of managing RIS data in Microsoft Excel with graphs as output. Figure 1 shows the progress of the research year. Based on the results of the analysis, the research progress graph shows that the highest number of studies will occur in 2022, with 97 studies; This shows an increase in research every year.

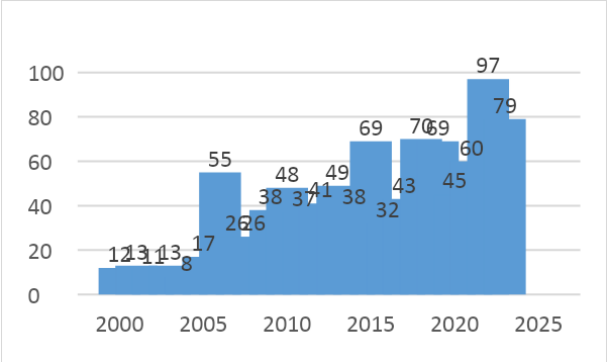


Table 2. ***Research progress graph***
(Source: Results of author's analysis)

Keyword Development

Based on the results of metadata retrieval on publish or perish and analyzed using vosviewer software version 1.6.19. A viasualization and clustering map is obtained as shown in figure 1 which is a map of research-related developments with a period of 2000-2023. From the results of the analysis, 3 clusters were obtained with 26 keywords related to research. With 26 keywords this has been organized into three clusters. The first cluster, shown in green, contains 7 keywords that include building information modeling, information management, cost management, project management, construction management, industry, engineering. In the second cluster, there are 8 keywords in red such as modeling, factor, construction industry, performance, bim technology, technique, design methodology approach, effectiveness. As for the third cluster, there are 5 keywords in yellow such as cost, time, impact, activity, organization. And the last cluester in blue there are 6 keywords such as information, facility management, building information modeling, efficiency, facilities management, quality. Below is a picture of network visualization keyword

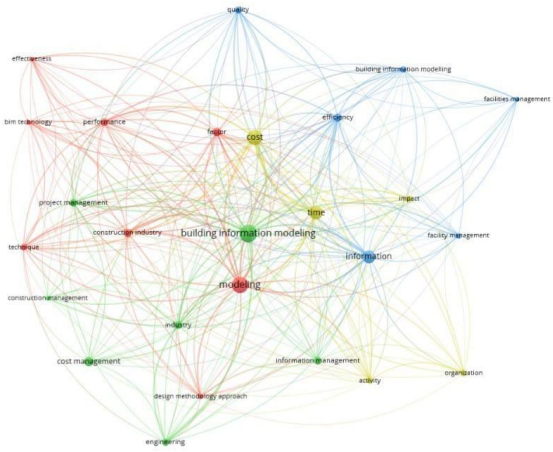


Figure 1. Network Visualization keyword
(source:Vosviewer research results version 1.6.19)

Trend mapping is done before clustering and mapping research. In addition, research is based on the year of publication of the article. The data obtained from overlay visualization can be used to assess the results of keyword analysis related to drainage capacity analysis research that has been conducted from 2000-2023. Below is an overlay image of visualization keyword.

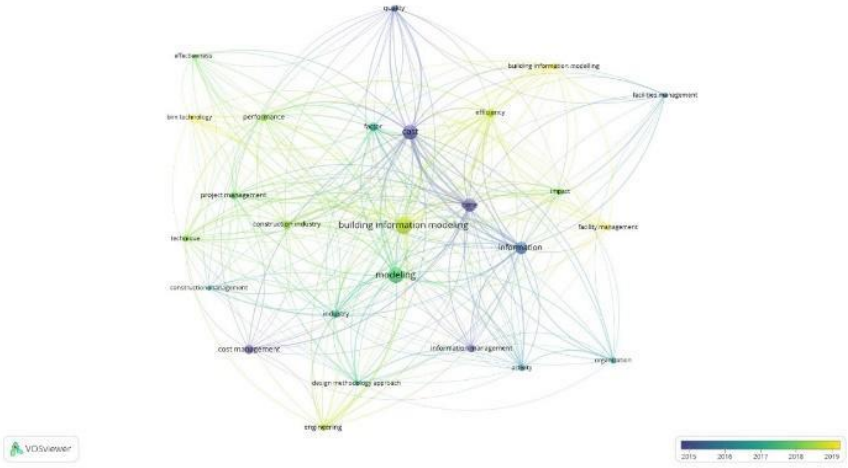


Figure 2. Overlay Visualization keyword
(source:Vosviewer researcher results version 1.6.19)

In figure 3 below shows the results of density visualization which shows many colors of nodes that are close to each other. The brightest node color indicates keywords that have been thoroughly studied in the study. Figure 3 shows keyword density visualization showing all topics related to research, bibliometric analysis, cost and time management in avalanche handling on national roads in mountainous areas using BIM. Below is the image of density visualization keyword

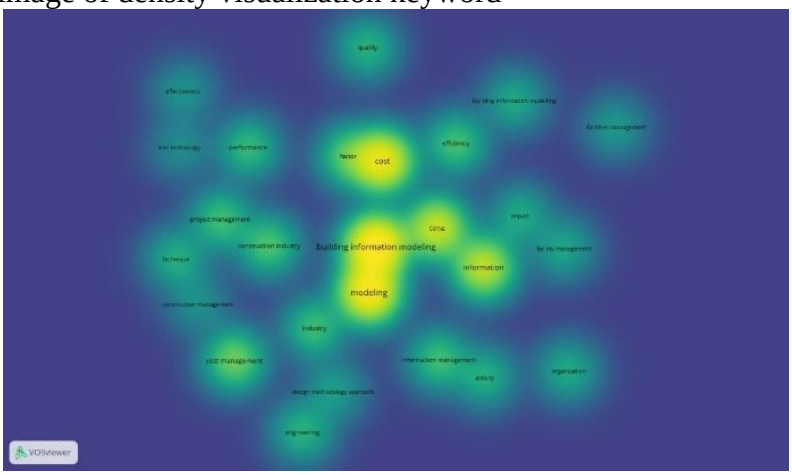


Figure 3. Density Visualization keyword
(source: Vosviewer researcher version 1.6.19)

Publisher Development

The results of data processing and CSV file analysis with the help of Microsoft Excel were found. The number of publishers on the withdrawal of methada on Crossef is 185 publishers out of a total of 1000 studies. The authors grouped the number of publishers involved in the study by taking a minimum of five published journals as the data limit. The results of data analysis and processing from IEEE publishers as many as 125

Table 3. Number of Research Publishers

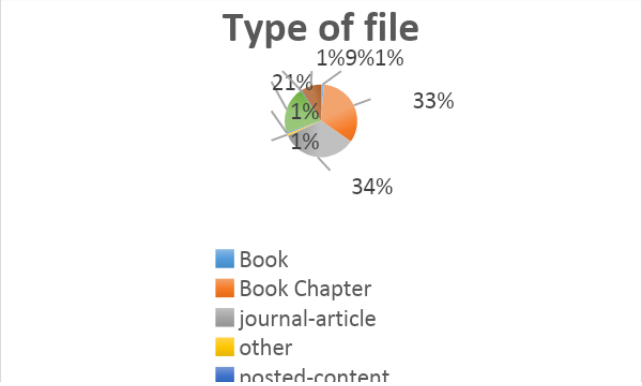
Pubisher	Sum
American Scientific Publishing Group	8

American Society of Civil Engineers	17
American Society of Civil Engineers (ASCE)	12
Atlantis Press	8
Auerbach Publications	42
Cambridge University Press	9
Cambridge University Press (CUP)	17
Chongqing VIP Information Co.,Ltd.	9
CRC Press	21
DETAIL	35
DETAIL - Institut für internationale Architektur-Dokumentation GmbH &; Co. KG	21
Edward Elgar Publishing	45
Elsevier	17
Elsevier BV	50
Emerald	21
IEEE	125
IGI Global	37
Inderscience Publishers	7
Informa UK Limited	45
MDPI AG	9
Routledge	26
SCITEPRESS - Science and Technology Publications	10
Springer Berlin Heidelberg	19
Springer International Publishing	41
Springer Science and Business Media LLC	8
Wiley	7

(Source: Author's analysis results using Ms.Excel apk)

Type of Publications

Based on the results of data processing and analysis on Ms.excel using CSV files on crossef metada withdrawal. The results of pulling data on Publish or Perish result in grouping file types. It can be seen in *figure 6 that the number of file types* obtained by the most research formats found in Publish or Perish is 33.7%.



(Source: Results of author's analysis using Ms.Excel apk)

Relevant and Occurance

Based on the results of analysis and data processing using vosviewer software version 1.6.19 and Ms.Excel. These results are related to keywords collected with Vosviewer. This keyword returns the Occurance and relevant values found in figure 5 and figure 6 below. The results of the analysis showed that Building Information Modeling was the most widely used keyword and was related to the study by 163.

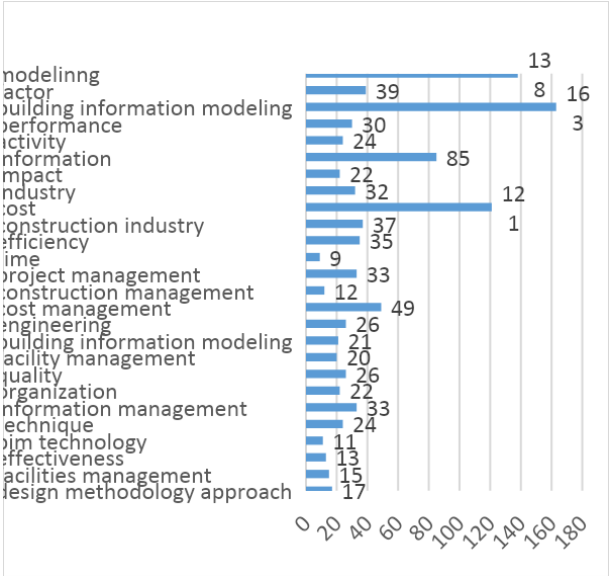


Figure 5 Relevant keywords
(Source:author's analysis results using Ms.Excel apk)

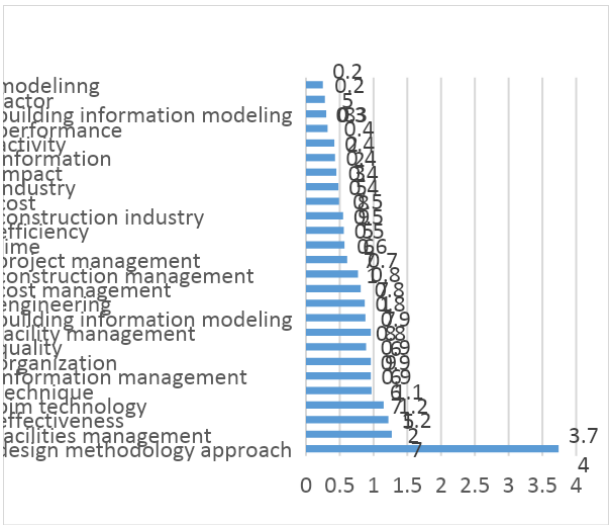


Figure 6. Keyword Occurrenceance
(Source:Results of author's analysis using Ms.Excel)

Country Development

Publish or Perish 8.9 data processing results are created with Microsoft Excel. Select a case study category for each research publication. Data was collected based on the number of case studies. Table 4 below shows the development of the country. This shows that America is the country with the most research topics and case studies on the use of BIM as many as 40 case studies. As for Indonesia, there are 8 research topics and case studies. Here's table 3 below

Table 4. Number of case studies

World	Number of Cases
Francis, German, Hongkong, Portugal, Serbia, Taiwan	1
Africa, China, Malaysia, Egypt	2
English	3
Indonesian	8
Korean	9
American	40

(Source: Author's analysis results using Ms.Excel apk)

Conclusion

The conclusion of this article is that dealing with disasters is very important, especially landslides, which pose a major threat to Indonesia's mountainous regions. This article suggests using the Building Information Model (BIM) as an inventive solution to address the complexity of this problem. In avalanche handling projects, using BIM is considered a way to improve cooperation, visualization, and overall project management. It is expected that BIM implementation will improve the accuracy, efficiency, and effectiveness of avalanche handling, which is often a challenging problem. This article establishes the hypothesis that BIM allows for more efficient cost and time management analysis. An additional purpose of this article is to provide policymakers and construction professionals with practical guidelines for analyzing and managing avalanche handling projects. The purpose of this article is to organize the literature. This article aims to organize the current literature and provide important insights into research advances in this field using bibliometric methods. This study used quantitative descriptive methods and bibliometric analysis to see research trends on cost management, time management, avalanche handling, and BIM. The data used is taken from the Scopus database and is limited to articles published within the last ten years. Thus, the bibliometric analysis used in this article provides a complete picture of the progress of the research.

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